

**CLAIMS:**

1. A method of forming a trench isolation region comprising:  
forming a trench within a substrate;  
forming a first layer comprising a silanol to partially fill the trench;

converting at least some of the silanol to a compound comprising at least one of  $\text{SiO}_n$  and  $\text{RSiO}_n$ , where R comprises an organic group;  
and

forming a second layer comprising an electrically insulative material over the converted silanol to within the trench.

2. The method of claim 1 wherein the trench has sidewalls, and further comprising thermally oxidizing at least some of the trench sidewalls intermediate the converting and the forming of the second layer.

3. The method of claim 1 wherein the trench has a trench depth, the first layer filling at least 25% of the trench depth.

4. The method of claim 1 wherein the trench has a trench depth, the first layer filling 35% or less of the trench depth.

1           5.    The method of claim 1 wherein the second layer fills the  
2 trench.

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4           6.    The method of claim 1 wherein the silanol comprises methyl  
5 silanol and R is a methyl group.

6  
7           7.    The method of claim 1 wherein the second layer is formed  
8 by chemical vapor deposition.

9  
10          8.    The method of claim 1 wherein the second layer is formed  
11 by plasma-enhanced chemical vapor deposition.

12  
13          9.    The method of claim 1 wherein the second layer comprises  
14  $\text{SiO}_2$ .

15  
16          10.   The method of claim 9 wherein the  $\text{SiO}_2$  is formed by a  
17 high density plasma.

18  
19          11.   The method of claim 1 wherein the trench comprises  
20 sidewalls, thermally oxidizing the sidewalls prior to forming the first  
21 layer.

1           12. The method of claim 1 wherein the trench comprises  
2 sidewalls, thermally oxidizing the sidewalls after forming the first layer  
3 and before forming the second layer.

4  
5           13. The method of claim 1 wherein the trench comprises  
6 sidewalls and the first layer adds 200 angstroms or less of layer to the  
7 sidewalls.

8  
9           14. The method of claim 1 wherein prior to forming the second  
10 layer, maintaining the first layer at a temperature of at least about 300°  
11 C and at a pressure of at least about 10 atmospheres effective to drive  
12 water from first layer.

13  
14           15. The method of claim 1 wherein converting the first layer  
15 comprises exposing the first layer to ultraviolet light.  
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1 16. A method of forming a trench isolation region comprising:  
2 forming a trench within a substrate;  
3 chemical vapor depositing an electrically insulating first layer to  
4 within the trench to partially fill the trench;  
5 forming a second layer comprising a silanol over the first layer to  
6 within the trench; and  
7 converting at least some of the silanol to a compound comprising  
8 at least one of  $\text{SiO}_n$  and  $\text{RSiO}_n$ , where "R" comprises an organic group.

9  
10 17. The method of claim 16 wherein the trench is formed in  
11 silicon, and wherein the chemical vapor depositing comprises substantially  
12 selectively depositing an oxide over exposed silicon within the trench.

13  
14 18. The method of claim 17 wherein the substantially selectively  
15 depositing the oxide comprises flowing  $\text{O}_3$  and TEOS to within the  
16 trench.

1           19. The method of claim 16 wherein the trench comprises  
2 silicon-comprising sidewalls and a silicon-comprising base, and further  
3 comprising forming an electrically insulative layer over the sidewalls and  
4 the base; anisotropically etching the insulative layer to expose silicon of  
5 the base while leaving silicon of the sidewalls covered; and the chemical  
6 vapor depositing comprising substantially selectively depositing an oxide  
7 over the exposed trench base.

8  
9           20. The method of claim 19 wherein the forming of the  
10 electrically insulative layer comprises chemical vapor deposition.

11  
12           21. The method of claim 19 wherein the electrically insulative  
13 material comprises silicon dioxide, and the forming of the electrically  
14 insulative layer comprises thermal oxidation.

15  
16           22. The method of claim 16 wherein the trench has sidewalls,  
17 and further comprising thermally oxidizing at least some of the trench  
18 sidewalls intermediate the chemical vapor depositing and the forming of  
19 the second layer.

20  
21           23. The method of claim 16 wherein the trench has a trench  
22 depth, the first layer filling at least 25% of the trench depth.

1           24. The method of claim 16 wherein the second layer fills the  
2 trench.

3  
4           25. The method of claim 16 wherein the silanol comprises methyl  
5 silanol and R is a methyl group.

6  
7           26. The method of claim 16 wherein the first layer is deposited  
8 by plasma-enhanced chemical vapor deposition.

9  
10          27. The method of claim 16 wherein the first layer comprises  
11  $\text{SiO}_2$ .

12  
13          28. The method of claim 27 wherein the  $\text{SiO}_2$  is deposited by  
14 a high density plasma.

15  
16          29. The method of claim 16 further comprising thermally  
17 oxidizing sidewalls of the trench prior to depositing the first layer.

18  
19          30. The method of claim 16 further comprising thermally  
20 oxidizing sidewalls of the trench after depositing the first layer and  
21 before forming the second layer.

1           31. The method of claim 16 further including maintaining the  
2 second layer at a temperature of at least about 300° C and at a pressure  
3 of at least about 10 atmospheres effective to drive water from the  
4 second layer.

5  
6           32. The method of claim 16 wherein converting the second layer  
7 comprises exposing the second layer to ultraviolet light.

8  
9           33. A method of forming a trench isolation region comprising:  
10 forming a trench within a substrate, the trench comprising silicon-  
11 comprising sidewalls and a silicon-comprising base;  
12 forming a first electrically insulative layer over the sidewalls and  
13 base;  
14 anisotropically etching the first electrically insulative layer to expose  
15 silicon of the base while leaving silicon of the sidewalls covered;  
16 substantially selectively chemical vapor depositing a second  
17 electrically insulative layer over the exposed trench base; and  
18 forming a third electrically insulative layer over the first and  
19 second insulative layers to within the trench.  
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1           34. The method of claim 33 wherein the third electrically  
2 insulative layer comprises a silanol, and further comprising converting at  
3 least some of the silanol to a compound comprising at least one of  $\text{SiO}_n$   
4 and  $\text{RSiO}_n$ , where R comprises an organic group.

5  
6           35. The method of claim 34 wherein the silanol comprises methyl  
7 silanol and R is a methyl group.

8  
9           36. The method of claim 33 wherein the substantially selectively  
10 depositing comprises flowing  $\text{O}_3$  and TEOS to within the trench to form  
11 an oxide.

12  
13           37. The method of claim 33 wherein the third electrically  
14 insulative layer comprises  $\text{SiO}_2$ .

15  
16           38. The method of claim 33 wherein the third electrically  
17 insulative layer is formed by plasma-enhanced chemical vapor deposition.

1 39. A method of forming a trench isolation region comprising:  
2 forming a trench within a substrate, and the trench comprising  
3 sidewalls and a base;

4 thermally oxidizing the sidewalls and base of the trench in an  
5 oxidizing environment, the oxidizing environment comprising oxygen and  
6 hydrogen and having a greater molar concentration of hydrogen than  
7 oxygen;

8 forming a layer comprising a silanol to within the trench; and  
9 converting at least some of the silanol to a compound comprising  
10 at least one of  $\text{SiO}_n$  and  $\text{RSiO}_n$ , where R comprises an organic group.

11  
12 40. The method of claim 39 wherein the silanol comprises methyl  
13 silanol and R is a methyl group.

14  
15 41. The method of claim 39 wherein the oxidizing environment  
16 further comprises maintaining the substrate at from  $800^\circ\text{C}$ . to  $1100^\circ\text{C}$ .

17  
18 42. The method of claim 39 wherein the oxidizing environment  
19 further comprises maintaining the substrate within a reactor having a  
20 pressure at from 10 Torr to 760 Torr.

1           43. The method of claim 39 wherein the oxidizing environment  
2 further comprises maintaining the substrate within a reactor at from  
3 800°C to 1100°C and a pressure at from 10 Torr to 760 Torr.

4  
5           44. A method of forming a trench isolation region comprising:  
6 forming a trench within a substrate, and the trench comprising  
7 sidewalls and a base;  
8 forming a layer comprising a silanol to within the trench;  
9 converting at least some of the silanol to a compound comprising  
10 at least one of  $\text{SiO}_n$  and  $\text{RSiO}_n$ , where R comprises an organic group;  
11 and  
12 after the converting, thermally oxidizing the sidewalls and base of  
13 the trench in an oxidizing environment.

14  
15           45. The method of claim 44 wherein the silanol comprises at  
16 least one of  $\text{Si}(\text{OH})_x$  and  $(\text{CH}_3)_y\text{Si}(\text{OH})_{4-y}$ , and the converting comprises  
17 converting at least some of the  $\text{Si}(\text{OH})_x$  if present to  $\text{SiO}_2$  and at least  
18 some of  $(\text{CH}_3)_y\text{Si}(\text{OH})_{4-y}$  if present to  $(\text{CH}_3)_x\text{SiO}_{2-x}$ .

19  
20           46. The method of claim 44 wherein the oxidizing environment  
21 further comprises maintaining the substrate in a reactor at from 850°C  
22 to 1150°C and a pressure at from 10 Torr to 760 Torr.

23

1 47. A method of forming a trench isolation region comprising the  
2 following steps:

3 forming a trench within a substrate;

4 forming a first layer comprising at least one of  $\text{Si(OH)}_x$  and  
5  $(\text{CH}_3)_y\text{Si(OH)}_{4-y}$  to partially fill the trench;

6 converting at least some of the  $\text{Si(OH)}_x$  if present to  $\text{SiO}_2$  and at  
7 least some of  $(\text{CH}_3)_y\text{Si(OH)}_{4-y}$  if present to  $(\text{CH}_3)_x\text{SiO}_{2-x}$ ; and

8 after the converting, forming a second layer comprising an  
9 electrically insulative material to within the trench.

10  
11 48. The method of claim 47 wherein the trench has sidewalls,  
12 and further comprising thermally oxidizing at least some of the trench  
13 sidewalls intermediate the converting and the forming of the second  
14 layer.

15  
16 49. The method of claim 47 wherein the trench has a trench  
17 depth, the first layer filling at least 25% of the trench depth.

18  
19 50. The method of claim 47 wherein the second layer comprises  
20  $\text{SiO}_2$ .

1           51. The method of claim 50 wherein the  $\text{SiO}_2$  is formed by a  
2 high density plasma.

3  
4           52. The method of claim 47 wherein the trench comprises  
5 sidewalls, and further comprising thermally oxidizing the sidewalls prior  
6 to forming the first layer.

7  
8           53. The method of claim 47 wherein the trench comprises  
9 sidewalls, and further comprising thermally oxidizing the sidewalls after  
10 forming the first layer and before forming the second layer.

11  
12           54. The method of claim 47 wherein the trench comprises  
13 sidewalls and the first layer adds 200 angstroms or less of layer to the  
14 sidewalls.

1           55. A method of forming a trench isolation region comprising the  
2 following steps:

3           forming a trench within a substrate;

4           forming a high density plasma proximate the substrate to deposit  
5 a first layer of material to partially fill the trench;

6           forming a second layer comprising at least one of  $\text{Si(OH)}_x$  and  
7  $(\text{CH}_3)_y\text{Si(OH)}_{4-y}$  over the first layer to within the trench; and

8           converting at least some of the  $\text{Si(OH)}_x$  if present to  $\text{SiO}_2$  and at  
9 least some of  $(\text{CH}_3)_y\text{Si(OH)}_{4-y}$  if present to  $(\text{CH}_3)_x\text{SiO}_{2-x}$ .

10  
11           56. The method of claim 55 wherein the trench has sidewalls,  
12 and further comprising thermally oxidizing at least some of the trench  
13 sidewalls intermediate the forming of the high density plasma and the  
14 forming of the second layer.

15  
16           57. The method of claim 55 wherein the trench has a trench  
17 depth, the first layer filling at least 25% of the trench depth.

18  
19           58. The method of claim 55 wherein the second layer fills the  
20 trench.

1           59. The method of claim 55 wherein the first layer comprises  
2 SiO<sub>2</sub>.

3  
4           60. The method of claim 55 wherein the trench comprises  
5 sidewalls, and further comprising thermally oxidizing the sidewalls prior  
6 to forming the first layer.

7  
8           61. The method of claim 55 wherein the trench comprises  
9 sidewalls, and further comprising thermally oxidizing the sidewalls after  
10 forming the first layer and before forming the second layer.

11  
12           62. The method of claim 55 further including maintaining the  
13 second layer at a temperature of at least about 300° C and at a pressure  
14 of at least about 10 atmospheres effective to drive water from second  
15 layer.

16  
17           63. The method of claim 55 wherein converting the second layer  
18 comprises exposing the second layer to ultraviolet light.